Attachment 1, NNL08243630Q
Statement of Work for 5-Axis Machining Center
April 8, 2008

One (1) Computer Numerical Controlled (CNC) 5-Axis Machining Center. The Machining Center shall be delivered FOB to Langley Research Center, Hampton, Virginia, off loaded and installed in Building 1225, Room 101 within 40 weeks after contract award. The Machining Center will be used in a research environment for the manufacture of highly accurate and unique aerospace hardware including prototype models, flight test articles, developmental instrumentation, and wind tunnel test equipment.

Computer Numerical Control (CNC) 5-Axis Machining Center

The 5-Axis Machining Center shall be furnished in accordance with the following specifications and requirements:

1. Shall be new construction of a standard commercial product offered for sale.
2. The overall footprint of the Machining Center, including operator station (s) and all peripheral equipment shall not exceed 260.000-Inches X 312.000-Inches. However, the installation site is adjacent to a 28.000-Inch wide covered utility trench. Any peripheral equipment that can be located in a 120.000 Inch X 312.000-Inch area across the utility trench, without interfering with trench access, as determined by the government, will be considered to have complied with the footprint requirements. (See attached sketch.)
3. Shall be capable of machining in the X, Y, Z, B, and C Axes.
4. Shall be capable of machining five (5) sides of a work piece in a single set-up.
5. Shall be capable of 5-Axis simultaneous machining.

6. Machining Center Capacities:
    6.1.1. Shall accept a minimum 10,000-pound work piece centrally located on the worktable.

6.1.2. Shall accept as a minimum a work piece that will fit inside a 94.000-Inch diameter by 51.000-Inch tall cylinder.

7. B-Axis:
   Shall be furnished with a Universal Swivel Milling Head that meets the following minimum requirements:
   7.1. Shall have a Computer Numerical Control (CNC) B-Axis.
   7.2. Shall be liquid cooled.

8. Spindle:
   8.1. Spindle drive motor shall generate a minimum of 135 foot-pounds of torque (100% duty cycle).
   8.2. Spindle Speed shall have a range of 20-Revolutions Per Minute (RPM) to a minimum of 12,000-RPM.
   8.3. Shall be furnished with a HSK-A 100 Spindle Taper.
   8.4. Shall have automatic taper cleaning by compressed air.

9. C-Axis:
   Shall be furnished with a CNC Rotary Table, C-Axis that meets the following minimum requirements:
   9.1. The Worktable shall measure a minimum of 66.000-Inches on the outside diameter. Opposed flatted surfaces on the table edge are permissible but shall measure a minimum of 27.0000-Inches from the centerline of the table.
   9.2. Shall be furnished with a reference T-Slot on the centerline of the table, slot shall be a nominal size with a tolerance of + 0.0008-Inch, -0.0000-Inch. Shall also be furnished with an additional 10 each T-Slots with 5 each T-Slots equally spaced on each side of the centerline that are a nominal size with a maximum tolerance of + 0.005-Inch, -0.0000-Inch.
   9.3. Shall generate a minimum of 12,500 foot-pounds of torque.
   9.4. Shall hold a minimum of 12,500 foot-pounds of cutting force.
   9.5. Shall support a minimum 10,000-Pound centrally located Work Piece.

10. Axes Travels:
    The Axis Travels and/or Rotary Motion shall meet the following minimum requirements:
    - 10.1. X-Axis – 70.000-Inches
    - 10.2. Y-Axis – 78.000-Inches
    - 10.3. Z-Axis – 43.000-Inches
    - 10.4. B-Axis – 180-Degrees from horizontal position
    - 10.5. C-Axis – 360-Degrees

11. Spindle Nose Clearance:
    - 11.1. In the vertical position the Spindle Nose shall have travels of 9.500-Inches or less above worktable to a minimum of 48-Inches above worktable.
    - 11.2. In the horizontal position the Spindle Nose shall have travels of 4.500-Inches or less above worktable to a minimum of 47.000-Inches above worktable.
    - 11.3. Spindle Nose / Spindle Centerline shall have a minimum of 5.000-Inches clearance from the table edge that is greatest distance from the table centerline in Y-Axis.

12. Axes Feed Rates:
    Axes shall have programmable Feed Rates that meet the following minimum requirements:
    - 12.1. X-Axis – 0.000-Inches Per Minute (IPM) to a minimum of 2,000-IPM
    - 12.2. Y-Axis – 0.000-IPM to a minimum of 1,500-IPM
    - 12.3. Z-Axis – 0.000-IPM to a minimum of 1,500-IPM
    - 12.4. B-Axis – 0-Revolutions Per Minute to a minimum of 23-Revolutions Per Minute
    - 12.5. C-Axis – 0-Degrees Per Minute to a minimum of 3,600-Degrees Per Minute

13. Axes Rapid Traverse Rates:
    The Axes shall meet the minimum Rapid Traverse Rates as follows:
    - 13.1. X-Axis – 2,000-IPM
    - 13.2. Y-Axis – 1,500-IPM
    - 13.3. Z-Axis – 1,500-IPM
    - 13.4. B-Axis – 23-Revolutions per Minute
    - 13.5. C-Axis – 10-Revolutions per Minute

14. Accuracies:

Axes shall meet the following minimum ISO 230-2-97 accuracies:

14.1. X, Y, and Z Axes:
14.2. Bidirectional A, 0.00032-Inch
14.3. Bidirectional Repeatability R, 0.0002-Inch
14.4. B-Axis Positioning Accuracy A, 9 arc seconds
14.5. Positioning Repeatability, +/- 0.00004 at Spindle Nose.
14.6. C-Axis Positioning Accuracy A, 9 arc seconds
14.7. Positioning Repeatability, 9 arc seconds

15. Measuring and Monitoring:

15.1. Ball Screw Drives and Feed Drives shall be cooled by liquid and/or air conditioning in all Axes.
15.2. Shall be furnished with Sensors for Temperature Feedback to the CNC and shall have automatic temperature compensation.
15.3. Shall be furnished with Digital Drives for all Axes.
15.4. Linear Scales shall provide positioning feedback in all axes to the CNC with resolution of 0.000039-Inch or less.
15.5. Shall be furnished with a Laser Based Tool Measuring device, which can be automatically stored in a protected enclosure when not in use.
15.6. Shall be furnished with an Infrared Measuring Probe with a HSK-A 100 tool shank.
15.7. Shall be furnished with Hardware and Software for Control and Accuracy Compensation of the machines 5-axis motion.

16. Tool Changer:

Shall be furnished with an Automatic Tool Changer that meets the following minimum requirements:

16.1. Shall be HSK-A 100 tooling compatible.
16.2. Shall be furnished with a tool shank cleaner.
16.3. Shall be furnished with a minimum 40-pocket tool magazine.
16.4. Each pocket shall accept a minimum 4.000-Inch diameter tool with adjacent pockets occupied and a minimum 8.000-inch diameter tool with empty adjacent pockets.

16.5. Each pocket shall accept tools of at least 16.000-Inches in length measured from the spindle nose.

17. Enclosure:

The Machine Enclosure shall meet the following minimum requirements:

17.1. Shall be furnished with a fully enclosed machining area.

17.2. Shall be furnished with sliding panels in the roof to allow loading of work pieces utilizing an overhead crane.

17.3. Shall be furnished with a large sliding door with a safety glass window at the front of the machine to allow loading of work pieces utilizing a crane.

17.4. Shall be furnished with a sliding door with a safety glass window at the side of the machine providing operator access to machine area.

17.5. Shall be furnished with sufficient lighting to illuminate the entire machine enclosure.

18. Coolant System:

Shall be furnished with a Coolant System as follows:

18.1. Shall have a minimum 650-gallon supply tank.

18.2. Shall have a minimum of 4 manually adjustable coolant supply nozzles at the milling head.

18.3. Shall be capable of being switched from liquid coolant to 90-psi shop air.

18.4. Shall have a minimum of 4 manually adjustable air blast coolant nozzles at the milling head.

18.5. Shall be furnished with Through the Spindle Coolant with a minimum of two (2) pressure settings; one pressure shall be a minimum of 500-psig (pounds per square inch gauge), and one pressure shall be a minimum of 1,000-psig and shall be capable of being switched from liquid coolant to 90-psig shop air.

18.6. Shall be furnished with a minimum of one (1) Rotating Clear View Port at operator’s station.

18.7. Shall be furnished with a Machine Enclosure Wash Down System that includes a coolant supply hose, spray nozzle, and dedicated pump.

18.8. Shall be furnished with a general-purpose chip conveyor integrated with the coolant system.

19. Electrical Supply:

The Machining Center shall be capable of operating from Government supplied 460 volts, 60 hertz AC power available at the site.

20. Air Supply:

All air-operated equipment shall be capable of operating from an air supply of 90 psig.

21. Computer Numerical Control (CNC):

As a minimum the CNC shall meet the following requirements:

21.1. Shall be furnished with an Industrial Based PC Control.
21.2. Shall be furnished with a minimum 32-Bit multi-processor.
21.3. Shall be furnished with a minimum 20 Gigabyte Hard Disk.
21.4. Shall be furnished with a minimum 3 Megabytes of Random Access Memory.
21.5. Shall be furnished with a Microsoft Windows XP Professional Operating System.
21.6. Shall be a 3-D Color Graphic Control.
21.7. Resolution shall be 0.00004-inch or less.
21.8. Shall be a software programmable multi-axis control with a minimum of three (3) linear interpolating axes and a minimum of two (2) circular interpolating axes.
21.9. Shall be furnished with Helical interpolation.
21.10. Shall be furnished with Cylindrical interpolation.
21.11. Shall have a minimum 99 block Look Ahead function and dynamic pre-control of acceleration, anticipated decoding of trajectory with detection of direction change.
21.12. Shall display in the English language.
21.13. Shall accept, process, and display in either the U.S. Customary system units (US) or in dual US and International system units (SI); but shall display in Inch units on power up.
21.14. Shall be Ethernet compatible and ready and have a built in Ethernet.
21.15. As a minimum shall be furnished with a 15-inch thin film transistor, color, liquid crystal display screen.
21.16. Shall be furnished with a touch screen operator interface.

21.17. Shall be furnished with a full-size Qwerty keyboard with a mouse.
21.18. Shall be furnished with a remote control box with electronic hand wheel to facilitate job set-up and machine operations and shall include provisions for the manual control of all axes.
21.19. Shall be furnished with a RJ 45 port.
21.20. Shall be furnished with a USB 2.0 port.
21.21. Shall display Maintenance Messages.

22. Lubrication:
22.1. Shall be provided with a means to ensure automatic and adequate lubrication for all moving parts. Each lubricant reservoir shall be identified by type of lubricant and shall have means for determining fluid level. All oil holes, grease fittings, and oil reservoirs shall conform or be otherwise compatible to S.A.E. Standards and be accessible for service.
22.2. Shall be furnished with type and quantity of oils and lubricants required by manufacturer to meet operational and industry standard warranty requirements.

23. Safety:
23.1. Shall comply with ANSI B11.23-2002 Safety Requirements for Machining Centers.
23.2. Shall be furnished with safety devices including limit stops, and warning signals to protect the machine against overloads, over travel, overheating, and malfunction of a component.
23.3. Shall be furnished with covers or other safety devices for all parts of the machine that present safety hazards to the operators.
23.4. Shall be fabricated such that all control cabinets, motors, metal conduits, control stations, and other devices, or areas where there is a possibility of contact with current carrying parts are grounded.
23.5. Shall be furnished with a manual fuse disconnect switch readily accessible to the operator that will deactivate the entire machining center.

24. Environment:

The noise level generated by the machining center shall not exceed 80 dBA within a 5-foot periphery of the machining center during the following conditions:

24.1. Machine fully energized.
24.2. Spindle running maximum RPM.
24.3. Coolant pump energized and running.
24.4. Axis slides moving at maximum speed.

25. Warranty:

The Contractor shall provide a minimum of a one (1) year warranty on the machining center to include parts and labor.

26. Installation:

26.1. The Contractor shall deliver the Machining Center FOB to Langley Research Center, Hampton, Virginia within 40 weeks after contract award.
26.2. After completing a safety briefing at Langley Research Center the Contractor shall off load and fully install and align the Machining Center in Building 1225, Room 101 within five (5) working days of delivery.
26.3. The Contractor shall provide all rigging services and the necessary rigging equipment required for removal of the Machining Center from the transport vehicle (s) and placement at the specified location. A list of crane and rigging providers will be furnished upon request.
26.4. The Government will provide electrical power and air connections to within five (5) feet of the designated connecting points of the machine.
26.5. The Contractor shall complete and make final electrical and air service connections from the prepared site to the machine.
26.6. Within twenty-four (24) hours or the next business day following installation, the Contractor shall demonstrate that the Machining Center and Control operates in accordance with the requirements in this document. As part of the demonstration, the Contractor shall conduct a performance test to be witnessed by the Government. The Government will provide the material, part file and/or drawing for the performance test.

27. Additional Required Deliverables:

27.1. The Contractor shall furnish one (1) set of foundation drawings within fifteen (15) days of contract award for the purpose of site preparation.

27.2. The Contractor shall provide the following documents and manuals a minimum of forty-five (45) days prior to shipment of the machining center:

27.2.1. Installation drawings, electrical wiring diagrams, and piping diagrams for air connections.

27.2.2. Two (2) hard copy sets of machine operation manuals.

27.2.3. Two (2) hard copy sets of control manuals.

27.2.4. Two (2) hard copy sets of machine maintenance and repair manuals that shall include drawings of equipment components, part names and numbers and suggested spare parts list.

27.3. All manuals and documents shall be in the English language.

27.4. US/SI units or US shall be used to graduate measuring and indicating devices such as scales, depth stops, dial indicators, pressure gauges, temperature indicators and other similar devices.

27.5. Characters shall be engraved, etched, embossed, or stamped in bold face on a contrasting background and shall be in the English language.

28. Training

28.1. The Contractor shall provide forty (40) hours of operator training at the NASA site for a minimum of three (3) operators beginning the workweek following completion of the activities in paragraph 26. The Contractor shall provide an additional 40 hours of operator training at the NASA site for a minimum of three (3) operators between 5 and six (6) weeks following the initial training.

28.2. Within thirty (30) days after installation the Contractor shall provide sixteen (16) hours of machine alignment and calibration training at the site for the third party contractor designated by NASA-Langley Research Center.